



PRODUCTION • TECHNOLOGY • DEVELOPMENT

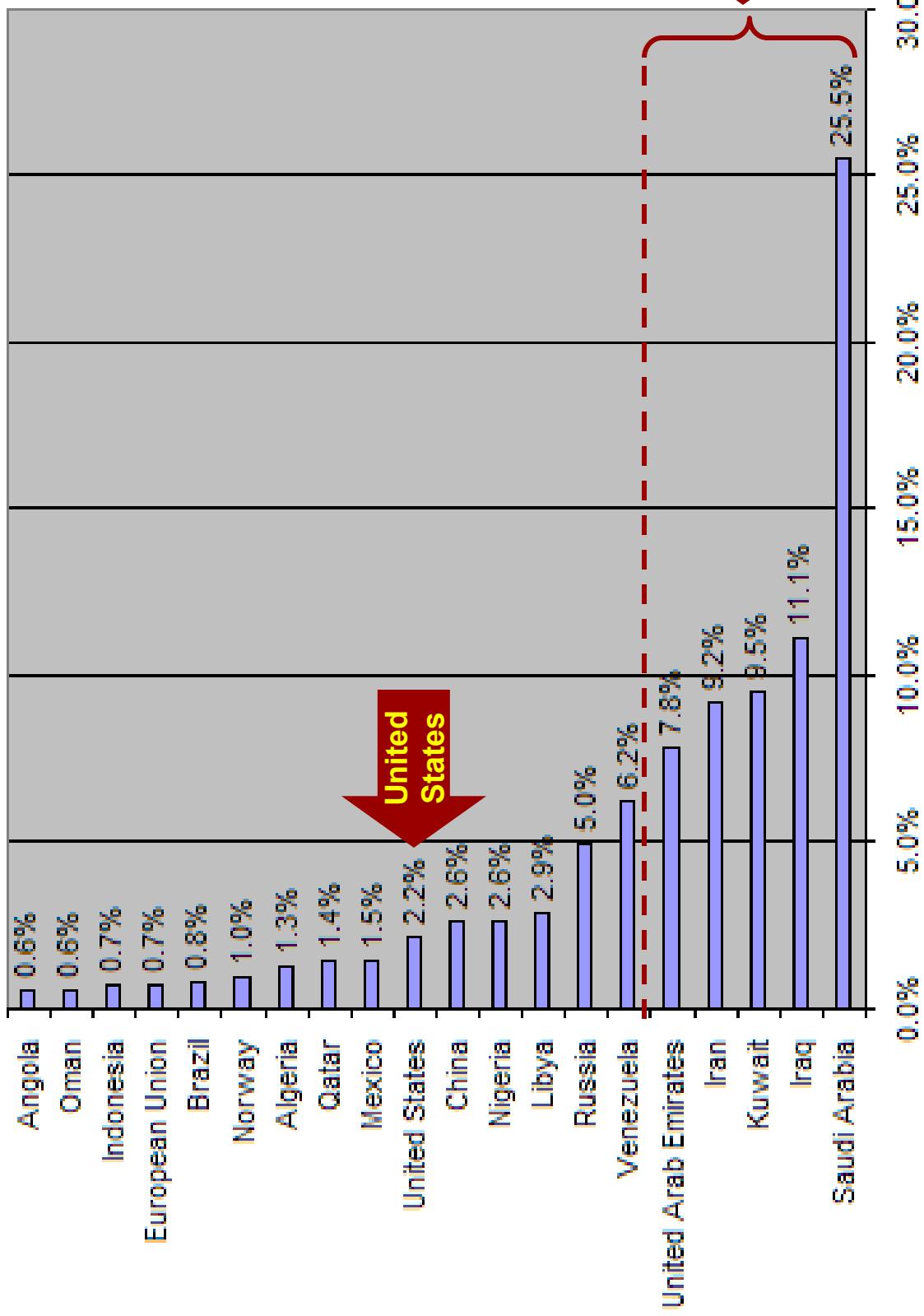
'Biodiesel 102': **An Introduction and Overview**

Michigan Clean Fleets Conference
March 22, 2006

PRESENTED BY JAKE STEWART
Vice President, Biodiesel Industries

Global Oil Reserves

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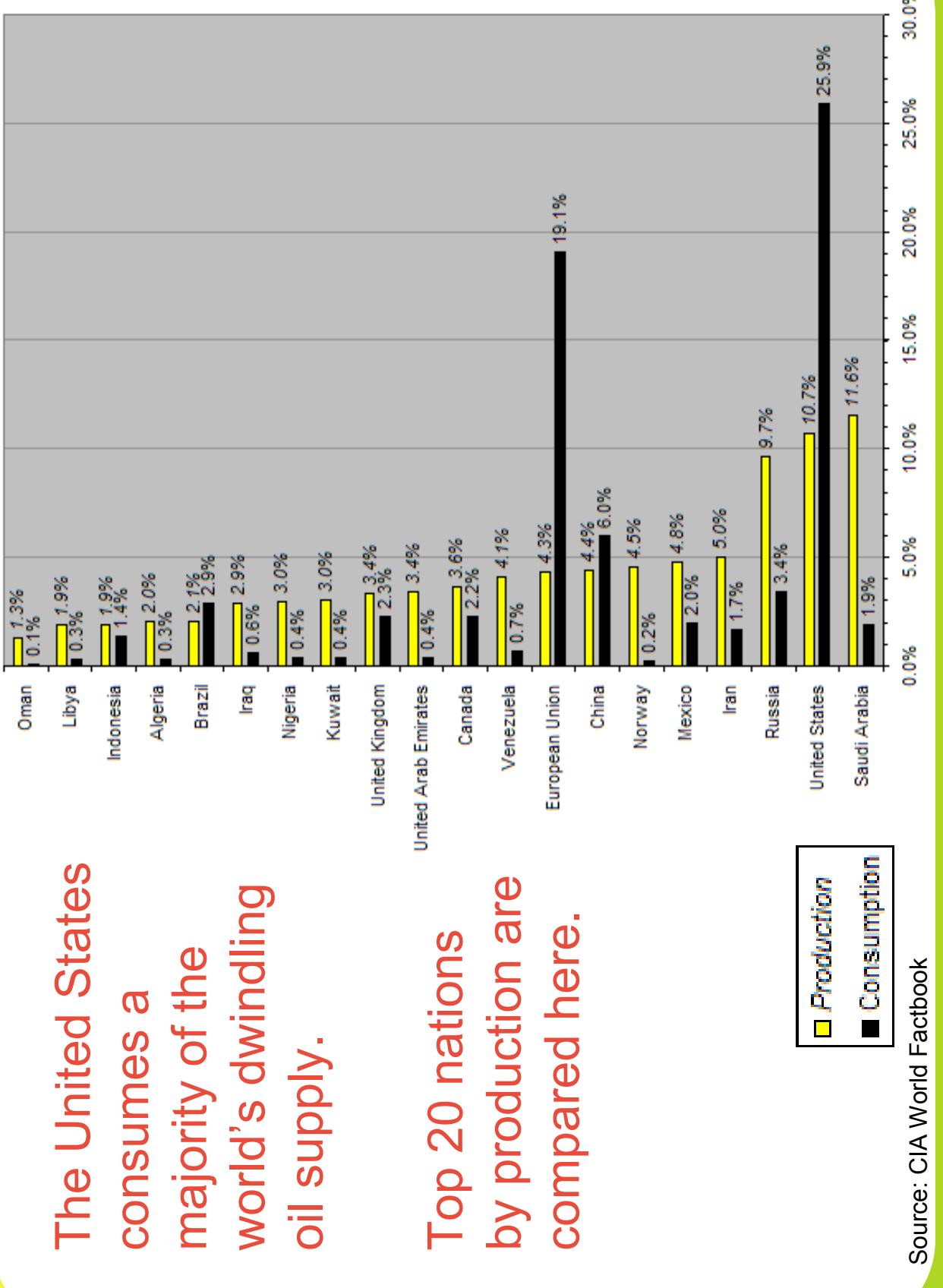
Source: CIA World Factbook

Oil Consumption vs. Production

1 2 3

- The United States consumes a majority of the world's dwindling oil supply.

- Top 20 nations by production are compared here.



Source: CIA World Factbook

The Big Picture

1 2 3

- Global demand for petroleum has exceeded the discovery of new reserves for the first time this year.
- The external costs of our increasing dependence on foreign petroleum are growing rapidly, both at home and abroad.
- Our society needs liquid energy. Without it everything grinds to a halt.
- Biodiesel provides a viable solution.

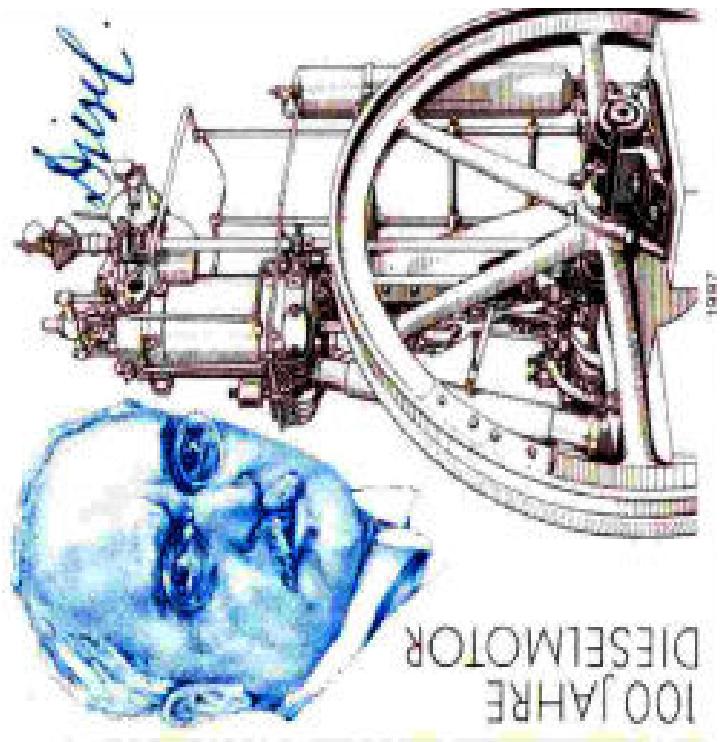


Diesel History

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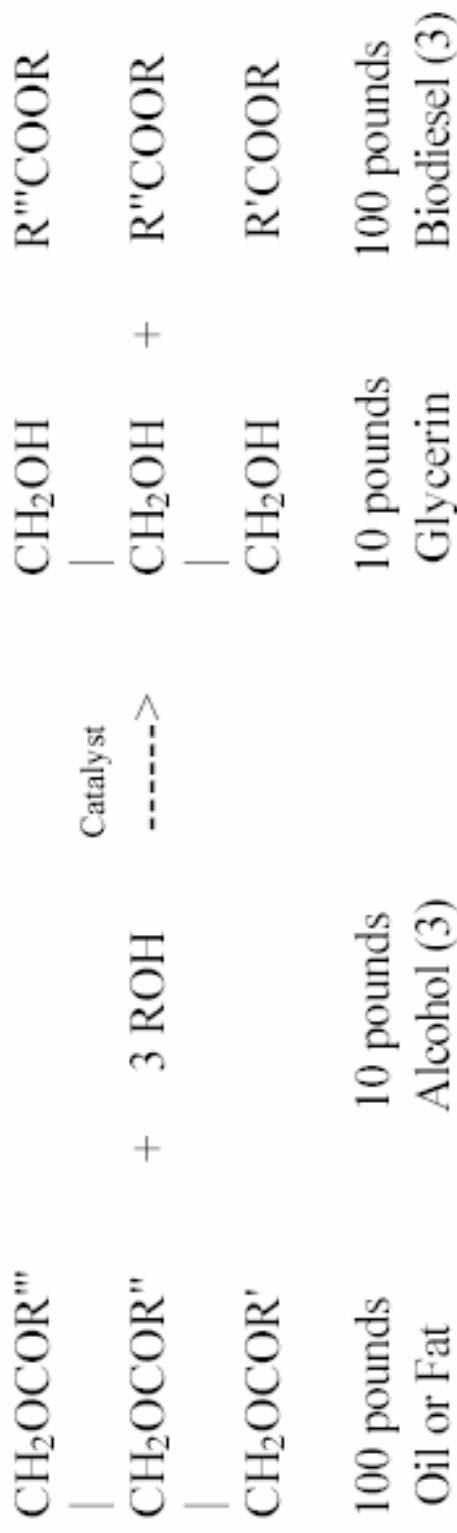
- When Dr. Rudolf Diesel created the diesel engine 100 years ago, it was tested using peanut oil.
- “The use of plant oil as fuel may seem insignificant today. But such products will in time become just as important as kerosene and these coal-tar-products of today.”

~R. Diesel, 1912



What is Biodiesel?

- Derived from vegetable oils and animal fats, not petroleum



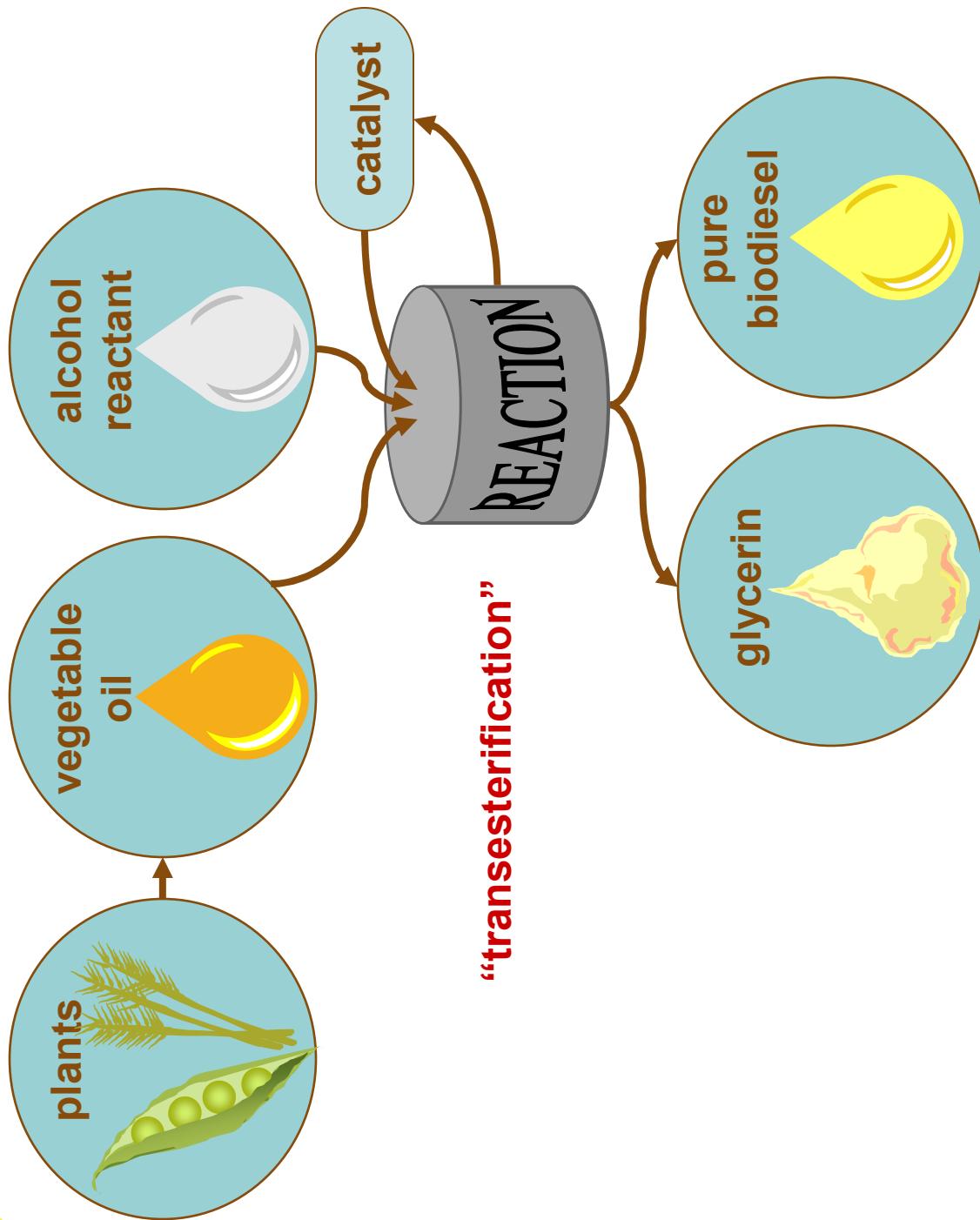
- Less toxic than table salt, biodegrades as fast as sugar
- Designated Alternative Fuel by USDOE
- Registered as a fuel & fuel additive with USEPA
- Specification set by ASTM 6751

Biodiesel is a responsible alternative to petroleum

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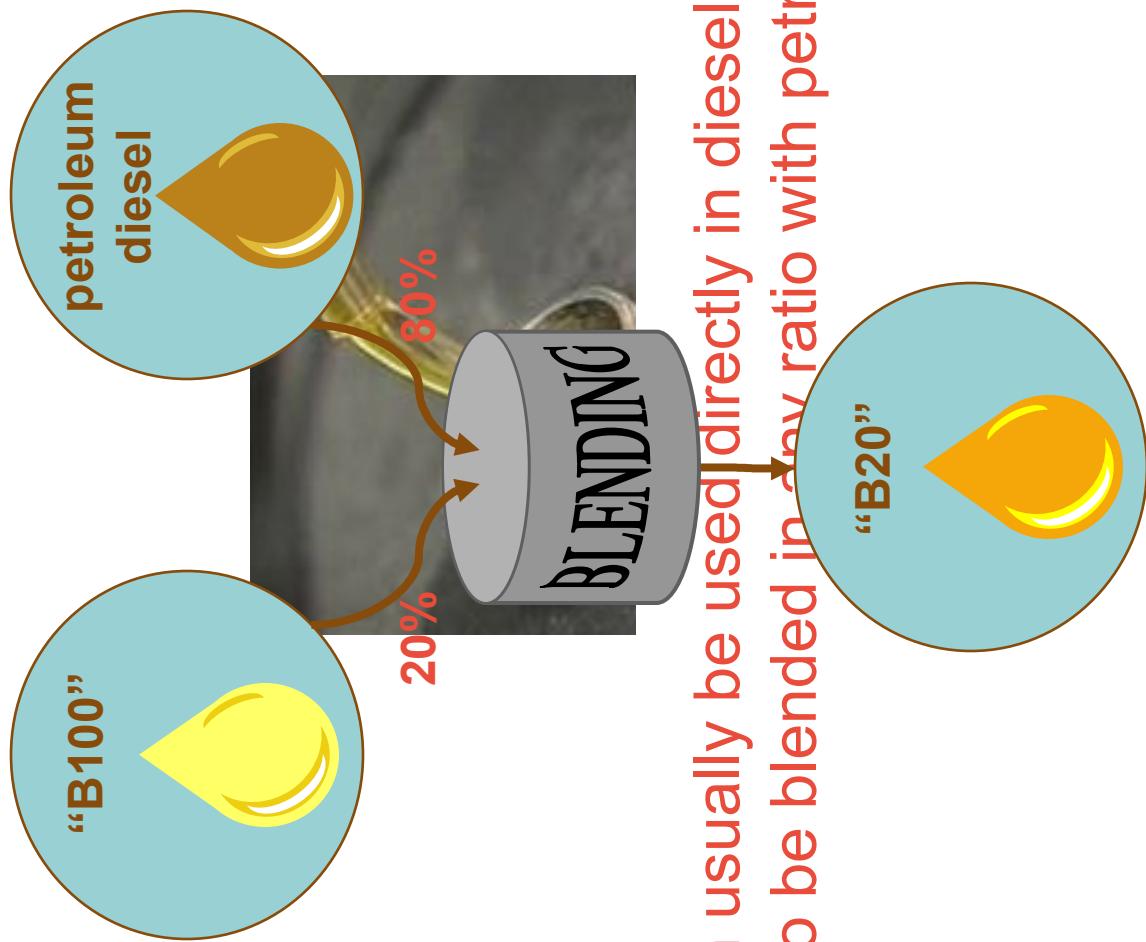
Biodiesel Production

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Biodiesel Blending

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- B100 can usually be used directly in diesel engines.
- It can also be blended in any ratio with petroleum diesel.

Biodiesel Benefits

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- Cleaner burning & non-toxic
- Domestically produced (energy security)
- Little to no infrastructure change needed to implement biodiesel
- Closed economic loop (\$ stays in state)
- Supports regional farmers
- Apolitical American fuel

Biodiesel Benefits

1 2 3

- Cleaner burning & non-toxic

- Less toxic than table salt
- Biodegrades as fast as sugar
- Low volatility, minimum flashpoint of 130°C (266°F)
- Emissions compared with petroleum diesel



Emission Type	B100	B20
Total Unburned Hydrocarbons	-67%	-20%
Carbon Monoxide	-48%	-12%
Particulate Matter	-47%	-12%
Sulfates (SO _x)	-100%	-20%
Nitrogen Oxides (NO _x)	+10%	+2%

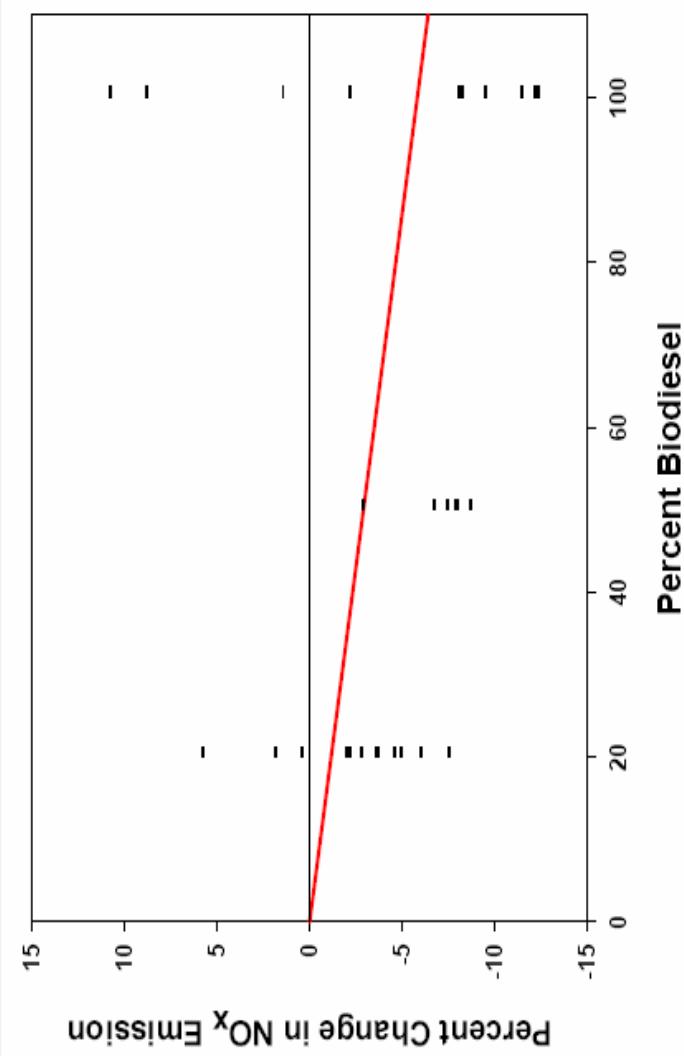
New DOE research drawing this to question

Biodiesel & NOx

1 2 3

Biodiesel's Effect on NO_x Emissions -Vehicle (Chassis) Data

- EPA study also reviewed published vehicle test data
- On average, NO_x was reduced in vehicle test studies
 - by 1.2% for B20



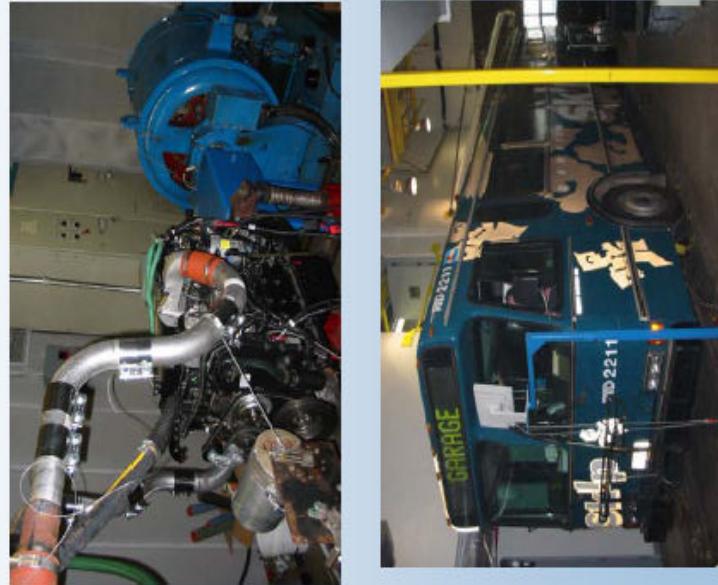
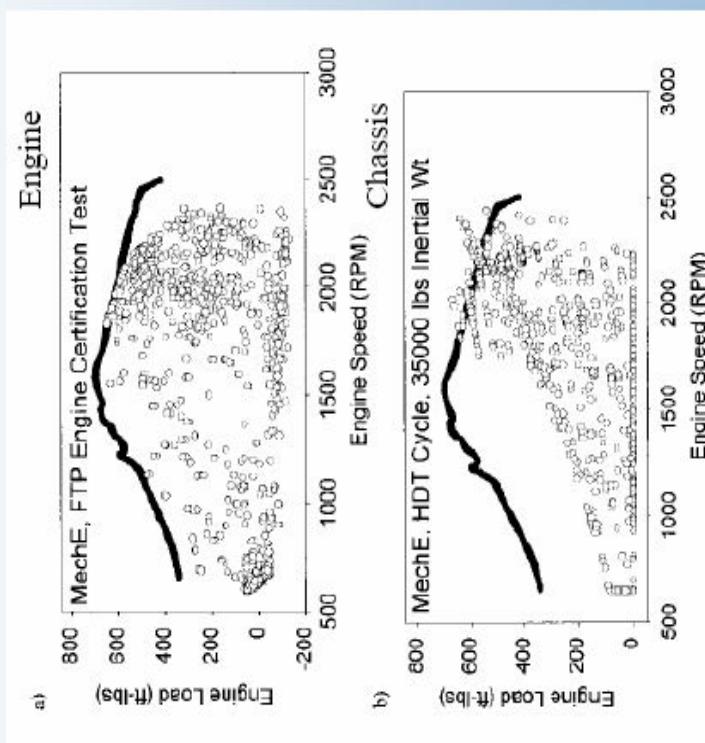
Data from EPA420-P-02-001, October 2002

Biodiesel & NOx

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Engine vs Chassis Test

Note difference in the speed and load points for the two different tests



Biodiesel Benefits

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- Cleaner burning & non-toxic
 - Offers energy self-sufficiency we desperately need
 - Lessens U.S. dependence on volatile foreign sources



Biodiesel Benefits

1 2 3

- Cleaner burning & non-toxic
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- Can be used in any diesel engine, including next generation diesel vehicles
- With attention to temperature control, can be stored and handled the same as petroleum diesel



Biodiesel Benefits

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- Cleaner burning & non-toxic
- – United States farmers will enjoy new value-add markets for their products.
- Demand for existing and emerging crops will fuel rural economic development.
- Farmers will be key to long-term biofuel growth
- – The future biodiesel feedstocks will rest on innovations:
 - A shift from ‘food crops’ to ‘fuel crops’
 - Utilization of marginal, non-irrigated land
 - Key to feasibility is maximizing oil per acre

Yield Estimates

Crop	kg oil/ha	litres oil/ha	lbs oil/acre	US gal/acre
corn (maize)	145	172	129	18
cashew nut	148	176	132	19
oats	183	217	163	23
lupine	195	232	175	25
kenaf	230	273	205	29
calendula	256	305	229	33
cotton	273	325	244	35
hemp	305	363	272	39
soybean	375	446	335	48
coffee	386	459	345	49
linseed (flax)	402	478	359	51
hazelnuts	405	482	362	51
euphorbia	440	524	393	56
pumpkin seed	449	534	401	57
coriander	450	536	402	57

Yield Estimates

1 2 3

Crop	kg oil/ha	litres oil/ha	lbs oil/acre	US gal/acre
mustard seed	481	572	430	61
camelina	490	583	438	62
sesame	585	696	522	74
safflower	655	779	585	83
rice	696	828	622	88
tung oil tree	790	940	705	100
sunflowers	800	952	714	102
cocoa (cacao)	863	1026	771	110
peanuts	890	1059	795	113
opium poppy	978	1163	873	124
rapeseed	1000	1190	893	127
olives	1019	1212	910	129
castor beans	1188	1413	1061	151
pecan nuts	1505	1791	1344	191
jojoba	1528	1818	1365	194
jatropha	1590	1892	1420	202
macadamia nuts	1887	2246	1685	240
brazil nuts	2010	2392	1795	255
avocado	2217	2638	1980	282
coconut	2260	2689	2018	287
oil palm	5000	5950	4465	635

Supports Regional Farmers

1 2 3

- United States farmers will enjoy new value-add markets for their products.

• **De** Made From American-Grown
economical Vegetable Oil

Home-Grown Energy: Oilseed Crops

Crambe



Rapeseed



Safflower



Soybean



Mustard



Flax

Sunflowers

Supports Regional Farmers

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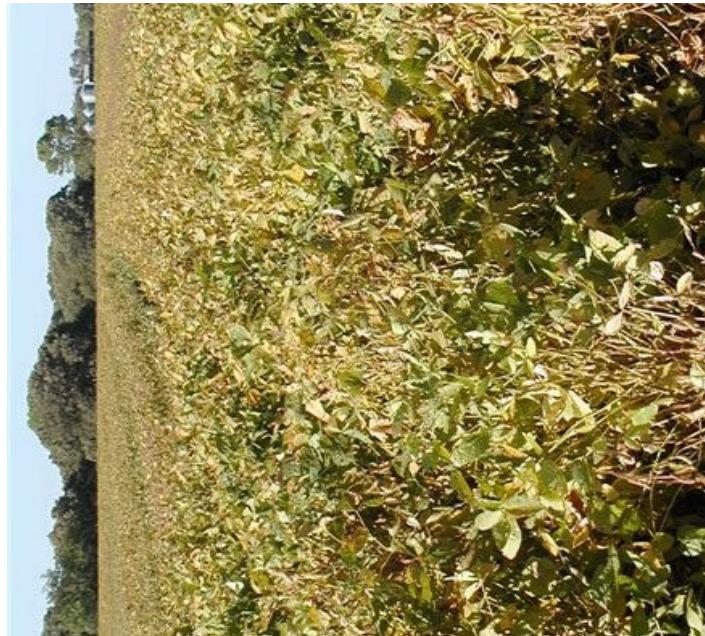
- Biodiesel supply chain integrates farmers as both a significant product market and vital feedstock source.
- Farm use of biodiesel is increasing.
- More than 1000 petroleum distributors now offer biodiesel to farmers.
- 30% of farmers use biodiesel, according to USB



Supports Regional Farmers

1 2 3

- Agriculture will be key to long-term biofuel growth
- The future biodiesel feedstocks will rest on innovations:
 - A shift from ‘food crops’ to ‘fuel crops’
 - Utilization of marginal, non-irrigated land



Biodiesel Market Growth

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Demand for biodiesel is growing for many reasons:

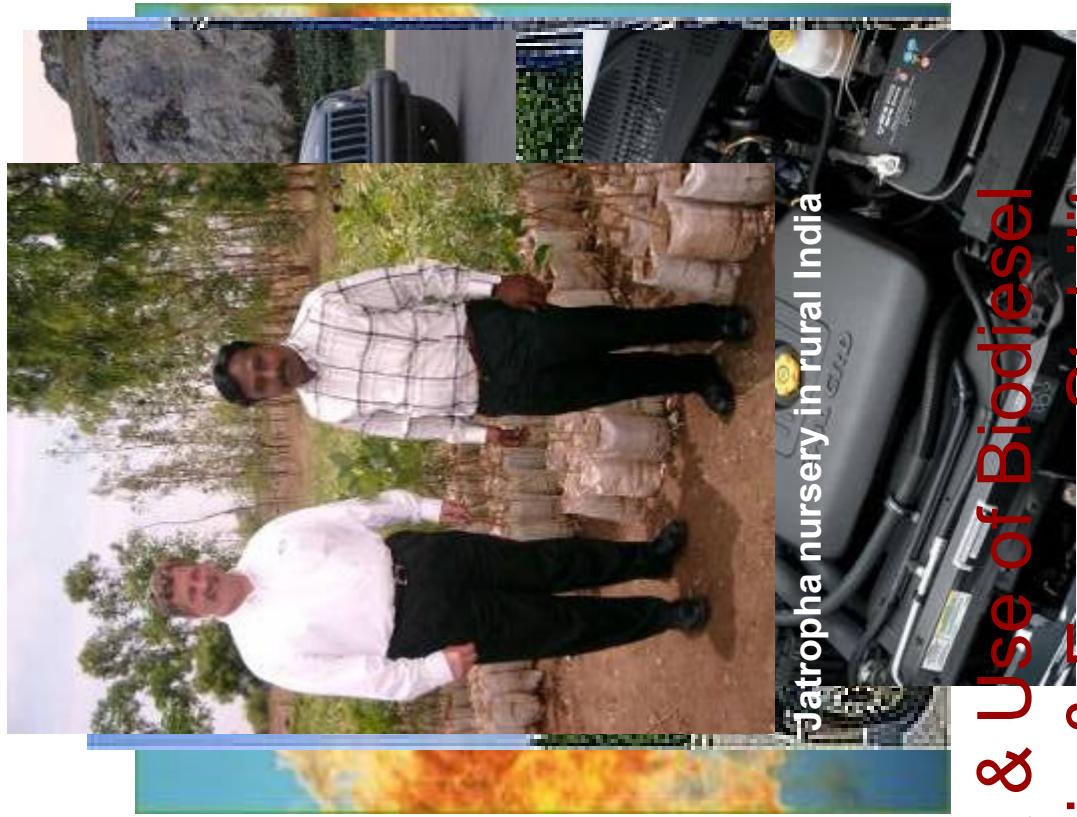
- Strong bi-partisan political support
- Renewable Power Standards
- State and local mandates
- EPACT fleets
- Publicly popular fuel
- Cost competitive
- Premium diesel



Looking Forward

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- Higher petroleum prices,
decreasing reserves,
increasing global demand
- More mandates,
regulations & incentives
- Low sulfur diesel & new
diesel vehicles
- Greater need for
economic development
programs based upon
energy self sufficiency



**Regional Development & Use of Biodiesel
Means Greater Economic & Energy Stability**

QUESTIONS.